LISA

SE&I Pre-Proposal Meeting

Systems Engineering Management

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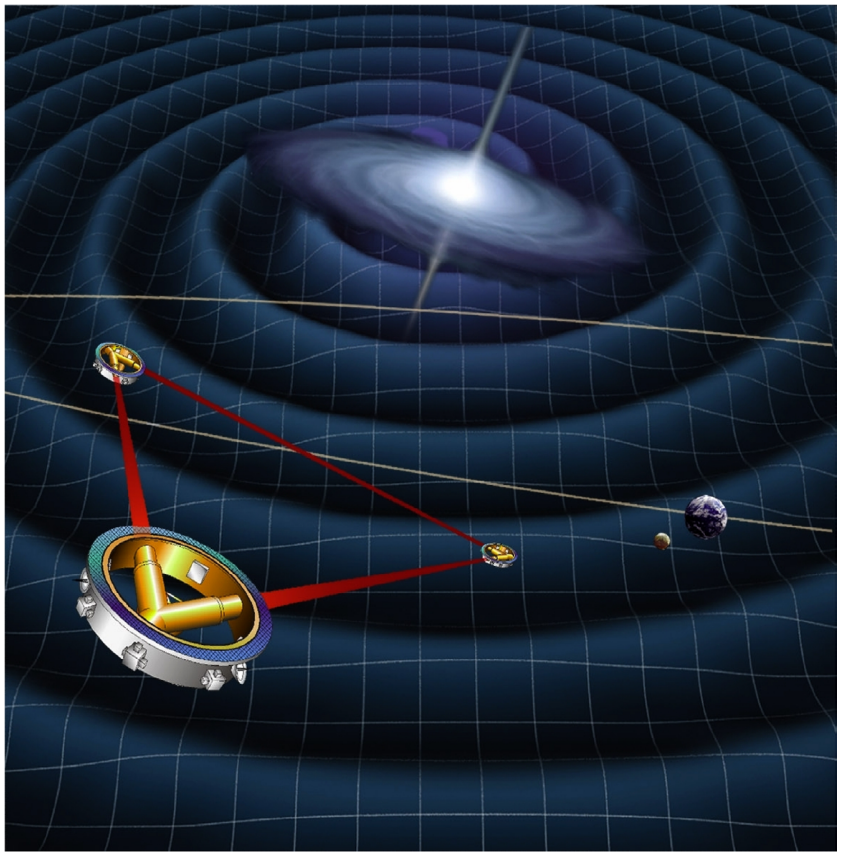
esa

LISA Overview

Beyond Einstein: From the Big Bang to Black Holes



- The Laser Interferometer Space Antenna (LISA) is an exciting science mission designed to detect gravitational waves from space
  - Provides an ability to view the Universe in a way we never saw before!
- The mission consists of three drag-free spacecraft nominally forming an equilateral triangle with 5 million kilometer arms. The constellation is placed in a heliocentric orbit
- Spacetime strains induced by gravitational waves are detected by measuring changes in the separation between masses using laser interferometry
- LISA is a joint NASA-ESA mission which enters Formulation in the summer of 2003 and launches in 2011

Organizational Chart Drivers

Beyond Einstein: From the Big Bang to Black Holes

- LISA's science is unique
  - Detecting gravitational waves from space
- LISA's partnering agreement is unique
  - The mission is an equal partnership between NASA and ESA
- LISA's system engineering is unique
  - The three spacecraft functioning as one system constitutes the measurement system. LISA is one integrated system.
  - The systems perspective is essential throughout the entire lifecycle

Project Roles & Responsibilities

- Roles and responsibilities are assigned on the strengths of each partner
- NASA/ GSFC emphasis is on:
  - Project management
  - System engineering
  - Software management
  - Observatory and constellation I&T
  - Launch vehicle procurement & processing
- JPL emphasis is on:
  - Mission Science
  - Payload management
  - Payload components and payload integration
  - Operations
- ESA emphasis is on:
  - Three Spacecraft
  - Three Propulsion Modules
  - Key payload components
  - Intermediate payload integration

Organizational Chart

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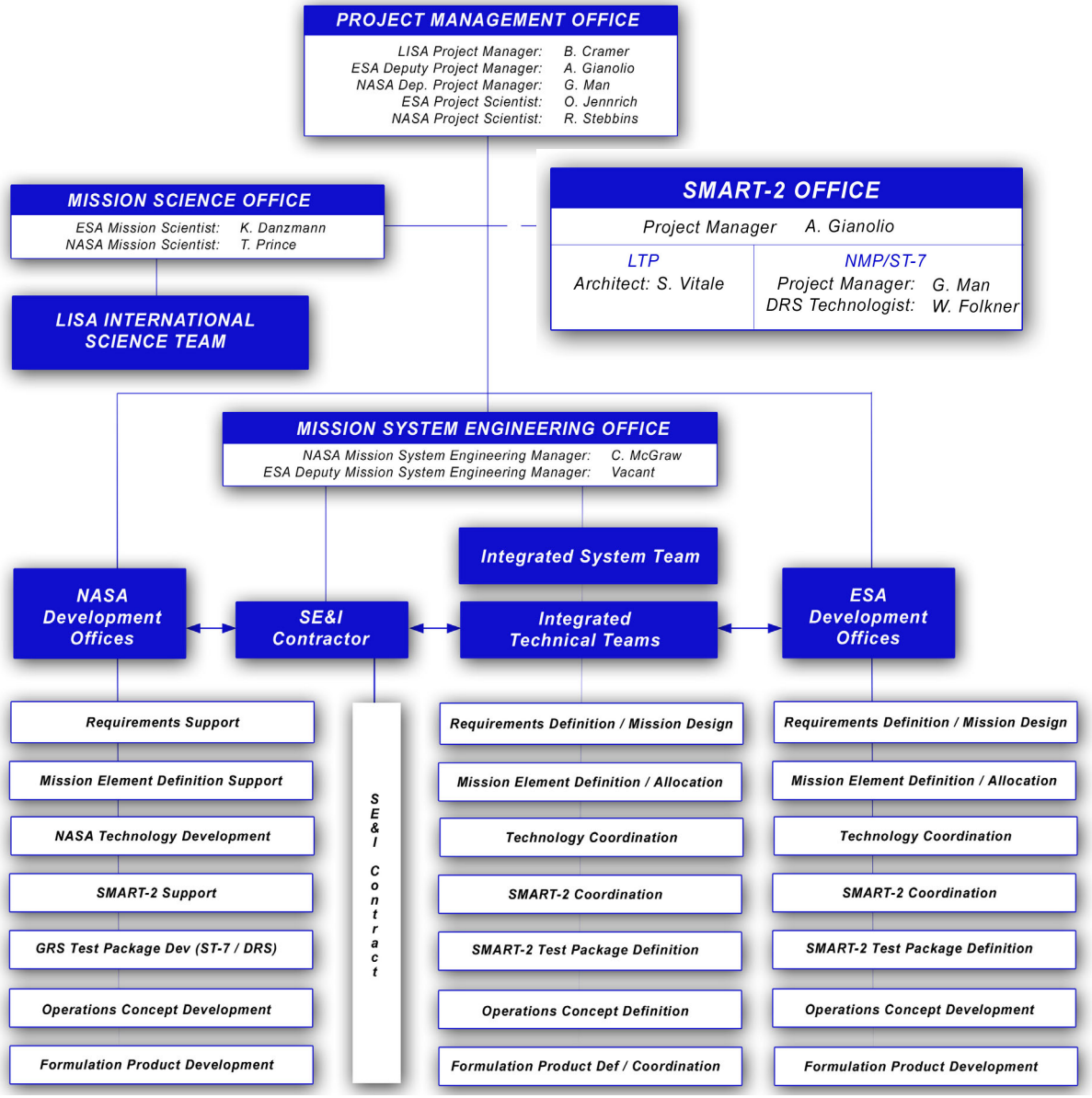

Systems Engineering Office

- The System Engineering Office (SEO) is responsible for ensuring system level coherence of all design and developmental activities of all project elements and ensures technical coherence of the LISA mission.
- System engineering capabilities are located within several Project elements, but their technical activities are coordinated through ONE System Engineering Team
- The SEO is responsible for the technical integrity of the mission including: systems, payload, spacecraft, ground system, and launch vehicle.
- NASA and ESA share the management of the SEO however, NASA/GSFC has the lead for day-to-day activities.
- SEO employs Integrated Technical Teams (ITT) and the Integrated Systems Team (IST) to facilitate collaboration between NASA and ESA

Integrated Systems Team

- The Integrated Systems Team accommodates the interests of both NASA and ESA
- Allows LISA to capitalize on the expertise in the US and Europe
- Is located within the SEO and co-chaired by the NASA/ESA System Engineering Managers
- Comprised of 6 scientists and 6 engineers from GSFC, JPL, ESA, and ESA member states.
- The IST is a cohesive technical team that assists the SEO in orchestrating the evolution of the design throughout all phases of the mission.
- IST supports the SEO with technical decisions

Integrated Technical Teams

- Integrated Technical Teams (ITT) accommodate each partner's interest
- Allows LISA to capitalize on the expertise in the US and Europe
- Integrated teams comprised of relevant members from NASA, ESA, and both SE&I contractors
- During formulation, ITT's emphasis is on design and definition
- During implementation, emphasis shifts to monitoring progress of the development, evaluating potential changes, and maintaining previously established ICD's
- Examples may include Operations, Mission Design, DRS, etc.

SE&I Contractor

- NASA SE&I contractor provides support to the GSFC SEO and the JPL Payload Office throughout the project lifecycle
  - Tasks may include requirements flow down, system verification and validation, interface definition and management, operations concept definition, design definition, software system engineering and risk management
  - In addition, the SE&I contractor may be responsible for payload and observatory integration and test, knowledge management systems, ground support fixtures and simulators, and development of mission software
- Major role of SE&I contractor is the staffing and coordination of the ITTs

LISA Project Master Schedule

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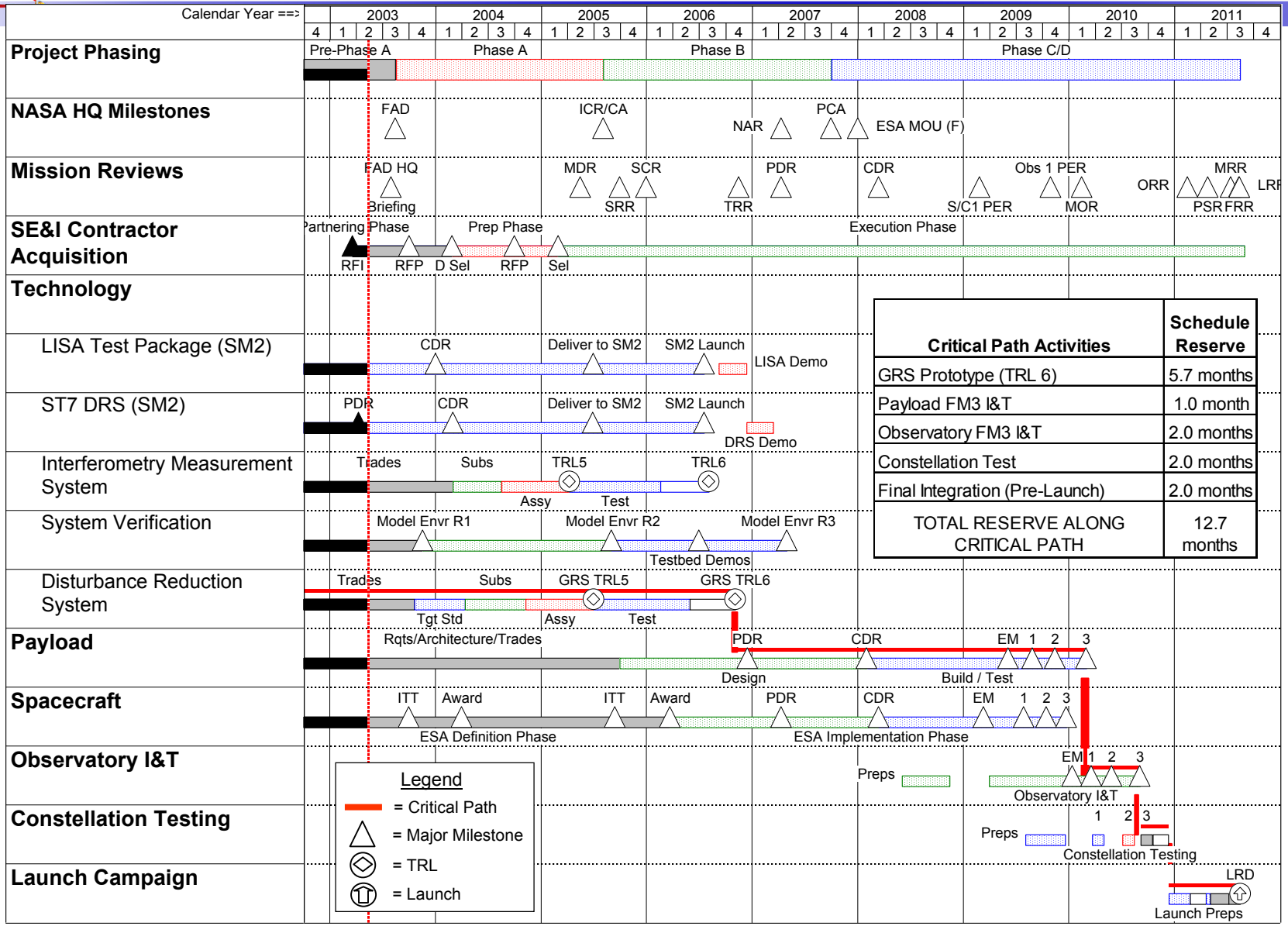

Critical Path Activities	Schedule Reserve
GRS Prototype (TRL 6)	5.7 months
Payload FM3 I&T	1.0 month
Observatory FM3 I&T	2.0 months
Constellation Test	2.0 months
Final Integration (Pre-Launch)	2.0 months
TOTAL RESERVE ALONG CRITICAL PATH	12.7 months

System Engineering Challenges

- Coordination of engineering efforts given the multiple teams located in multiple countries.
- Hardware components from multiple facilities including NASA, Universities, Industry, ESA, and European Member States
- The Systems Engineering Office must have insight and track technical progress at a much lower level than previously done on NASA missions.
- The three spacecraft must act as ONE system.
- The technical and organizational integrated nature of LISA calls for a unique System Engineering organization.